TEST REPORT

Test Report No.: UL-RPT-RP-14775495-616-FCC

Applicant *	:	ELECTROSTAR GmbH
Model No. *	:	GCA30-42
FCC ID *	:	TXTGCA3042
Technology *	:	Bluetooth – Low Energy
Test Standard(s)	:	**FCC Parts 15.207, 15.209(a) & 15.247** For details of applied tests refer to test result summary

1. This test report shall not be reproduced in full or partial, without the written approval of UL International Germany GmbH.
2. The results in this report apply only to the sample tested.
3. The test results in this report are traceable to the national or international standards.
4. **Test Report Version 1.2 supersede Version 1.1 with immediate effect**
   Test Report No. UL-RPT-RP-14775495-616-FCC Version 1.2, Issue Date 14 MAY 2024 replaces
   Test Report No. UL-RPT-RP-14775495-616-FCC Version 1.1, Issue Date 07 MAY 2024, which is no longer valid.
5. Result of the tested sample: **Pass**
6. All information marked with a (*) were provided by customer / applicant or authorized representative

Prepared by: Muhammad Faiq Khan
Title: Project Engineer
Date: 14 May 2024

Approved by: Rachid, Acharkaoui
Title: Operations Manager
Date: 14 May 2024

Deutsche Akkreditierungsstelle D-PL-19381-02-00

This laboratory is accredited by DAkkS.
The tests reported herein have been performed in accordance with its' terms of accreditation.

UL INTERNATIONAL GERMANY GMBH
Hedelfinger Str. 61
70327 Stuttgart, Germany
STU.CTECHLab@ul.com

This page has been left intentionally blank.

Table of Contents

1. Customer Information *

1.1. Applicant Information

Company Name:	ELECTROSTAR GmbH
Company Address:	Hans-Zinser-Str 1-3 , 73061 Ebersbach an der Fils
Contact Person:	Bernd Lustig
Contact E-Mail Address:	+49 7163 9988 246
Contact Phone No.:	bernd.lustig@starmix.de

1.2. Manufacturer Information

Company Name:	Robert Bosch Power Tools GmbH
Company Address:	70538 Stuttgart, GERMANY
Contact Person:	Jana Bieser
Contact E-Mail Address:	+49 711 758 3871
Contact Phone No.:	Jana.Bieser@de.bosch.com

2. Summary of Testing

2.1. General Information

Applied Standards

Specification Reference:	47CFR15.247
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Section 15.247
Specification Reference:	47CFR15.207 and 47CFR15.209
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Sections 15.207 and 15.209

Location

Location of Testing:	UL International Germany GmbH Hedelfinger Strasse. 61, 70327 Stuttgart, GERMANY
Registration Number:	399704

Date Information

Order Date:	20 April 2023
EUT Arrived:	01 June 2023
Test Dates:	13 September 2023 to 19 December 2023
EUT Returned:	-/-

2.2. Summary of Test Results

DIGITAL TRANSMISSION SYSTEMS (DTS): 2400-2483.5 MHz					
FCC Part 15 Clause	Compliance Test Description	Test Result			
		C	N.C.	N.P.	N.A.
15.207	Transmitter AC Power Line Conducted Emissions	☒	☐	☐	☐
Part 15.247(a)(2)	Transmitter Minimum 6 dB Bandwidth	☒	☐	☐	☐
Part 15.35(c)	Transmitter Duty Cycle (2)	☒	☐	☐	☐
Part 15.247(e)	Transmitter Power Spectral Density (1)	☐	☐	☒	☐
Part 15.247(b)(3)	Transmitter Maximum (Peak) Output Power	☒	☐	☐	☐
15.247(d) & 15.209(a)	Transmitter Radiated Emissions	☒	☐	☐	☐
15.247(d) & 15.209(a)	Transmitter Band Edge Radiated Emissions	☒	☐	☐	☐
C: COMPLIED | N.C.: NOT COMPLIED | N.P.: NOT PERFORMED | N.A.: NOT APPLICABLE					

Decision rule:
Where not otherwise specified or communicated in writing, statements of conformity (e.g. Pass/Fail) are established according to the following decision rule: considering the ILAC G8:2019 chapter 4.2.1 (simple acceptance rule). This leads to a maximum 50% of false accept or false reject when the measured value equals the tolerance limit. See ILAC-G8:09/2019 for further details.

Note(s):

1. In accordance with ANSI C63.10-2013 Section 11.10.1, PSD is not required if the maximum conducted output power is less than the PSD limit of 8 dBm / 3 kHz. The PSD level is therefore deemed to be equal to the measured total output power.
2. The measurement was performed to assist the average measurements.

2.3. Methods and Procedures

Reference:	ANSI C63.10-2013
Title:	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
Reference:	FCC KDB 558074 D01 DTS Meas. Guidance v05r02 April 2, 2019
Title:	Guidance for compliance measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating Under Section 15.247 of the FCC rules
Reference:	FCC KDB 174176 D01 Line Conducted FAQ v01r01 June 3, 2015
Title:	AC Power-Line Conducted Emissions Frequently Asked Questions

2.4. Deviations from the Test Specification

For the measurements contained within this test report, there were no deviations from, additions to, or exclusions from the test specification identified above.

3. Equipment Under Test (EUT)

3.1. Identification of Equipment Under Test (EUT) *

Brand Name:	BOSCH
Model Name or Number:	GCA30-42
Test Sample Serial Number:	Not Serialised (Radiated Test Sample)
Hardware Version Number:	9.1.13
Firmware Version Number:	2.2
FCC ID:	TXTGCA3042

Brand Name:	BOSCH
Model Name or Number:	GCA30-42
Test Sample Serial Number:	Not Serialised (Conducted Test Sample with SMA connector)
Hardware Version Number:	9.1.13
Firmware Version Number:	2.2
FCC ID:	TXTGCA3042

3.2. EUT Family Models / Parts *

Part Numbers:	1600A02GF0

Note(s):

1. According to customer declaration all the above-mentioned models (part numbers) are identical with the tested EUT and only differ in the printing label.

3.3. Description of EUT *

The equipment under test was a Smart Plug (GCA30-42) with BT LE interface, supporting Bluetooth Low Energy operations in 2400-2483.5MHz ISM band.

3.4. Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing.

3.5. Additional Information Related to Testing *

Technology Tested:	Bluetooth – Low Energy		
FCC Equipment Classification:	Digital Transmission System (DTS)		
Type of Unit:	Transceiver		
Operating Frequency Range:	2402 MHz to 2480 MHz		
Channel Spacing:	2 MHz		
Tested Data Rate(s) & Modulation(s):	1 Mbps	GFSK	
Maximum Conducted Output Power:	1.96 dBm		
Declared Antenna Gain:	2.4 dBi		
Antenna Type:	Integrated Antenna		
Antenna Details:	PCB Antenna		
Transmit Channels Tested:	**Channel ID**	**RF Channel**	**Frequency (MHz)**
	Bottom	0	2402
	Middle	19	2440
	Top	39	2480
Power Supply Requirement(s):	5V DC via USB cable		
Highest internally generated clock and/ or oscillator frequency:	Internal RC Oscillator 16MHz External crystal 32MHz		

3.6. Support Equipment

The following support equipment was used to exercise the EUT during testing:

A. Support Equipment (In-house)

Item	Description	Brand Name	Model Name or Number	Serial Number
1	-/-	-/-	-/-	-/-

B. Support Equipment (Manufacturer supplied) *

Item	Description	Brand Name	Model Name or Number	Serial Number
1	Test Laptop With Test software BlueNRG GUI v4.5.0	HP	ProBook 440 G6	5CD941CVQY

4. Operation and Monitoring of the EUT during Testing

4.1. Operating Modes

The EUT was tested in the following operating mode(s):
☒ BT-LE Test Mode: Continuously transmitting modulated carrier with combination of • Data Rate: 1 Mbps | Packet Type: PRBS9 | Power Settings: 5 | Channel: Bottom / Middle / Top

4.2. Configuration and Peripherals

The EUT was tested in the following configuration(s):

EUT Power Supply:

- The EUT was powered with 5 V DC through a USB Cable via Laptop:

Test Mode Activation:

- The EUT can be connected with the Test laptop via USB cable. The laptop was removed from the measuring area during the measurement.
- The test modes were activated using the test software / Radio Tool “BlueNRG GUI v4.5.0”. This test software / Radio Tool was installed on the test laptop to enable continuous transmission and to select the required test channels.

AC Conducted Emissions Measurements:

- The EUT radiated sample was used for AC conducted emissions measurements.
- The measurements were carried out with 120 VAC/60Hz & 240 VAC/60Hz.
- The Toyo EMI Software EP5/CE Ver 4.0.1. was used for these measurements.

Conducted Measurements:

- All conducted measurements were carried out by using the EUT RF sample with SMA cable soldered on the PCB. The SMA RF cable’s attenuation (maximum 0.5 dB@2.4GHz) was added to as a reference level offset to each of the conducted plots.

Radiated Measurements:

- The EUT radiated sample was used for radiated spurious emission and band edge measurements.
- Before starting the measurement, the EUT was evaluated for the worst-case position w.r.t to maximum radiated power measured in standing, laying and 45° tilting positions. The EUT integrated antenna in standing position was found out to be the worst-case. Therefore, this report includes relevant results.
- Radiated measurements below 30 MHz were performed with the EUT positioned on the turn table and rotating 360 degrees while the loop antenna height was set at 100 cm.
- Radiated measurements above 30 MHz were performed with the EUT positioned on the turn table and rotating 360 degrees while the antenna height varies from 1 to 4 m over the measurement frequency range.
- R&S® EMC32 V11.30.00 Software was used for the Radiated spurious emission measurements.

Duty Cycle Correction Details:

- As the continuous transmission of the EUT (D ≥ 98%) cannot be achieved and EUT was transmitting continuously with 61.62% duty cycle (+/- 2% tolerance). Duty Cycle Correction Factor of 2.1 dB was added to all average measurements.

5. Measurements, Examinations and Derived Results

5.1. General Comments

Measurement uncertainties are evaluated in accordance with current best practice. Our reported expanded uncertainties are based on standard uncertainties, which are multiplied by an appropriate coverage factor to provide a statistical confidence level of approximately 95%. Please refer to Section 6 *Measurement Uncertainty* for details.

In accordance with DAkkS requirements all the measurement equipment is on a calibration schedule. All equipment was within the calibration period on the date of testing.

5.2. Test Results

5.2.1. Transmitter AC Conducted Spurious Emissions

Test Summary:

Test Engineer:	Muhammad Faiq Khan	**Test Date:**	19 December 2023
Test Sample Serial Number:	Not Serialised (Radiated Test Sample)		
Test Site Identification	SR 7/8		

FCC Reference:	Part 15.207
Test Method Used:	ANSI C63.10 Section 6.2 / FCC KDB 174176 and notes below

Environmental Conditions:

Temperature (°C):	22.3
Relative Humidity (%):	46.0

Settings of the Instrument

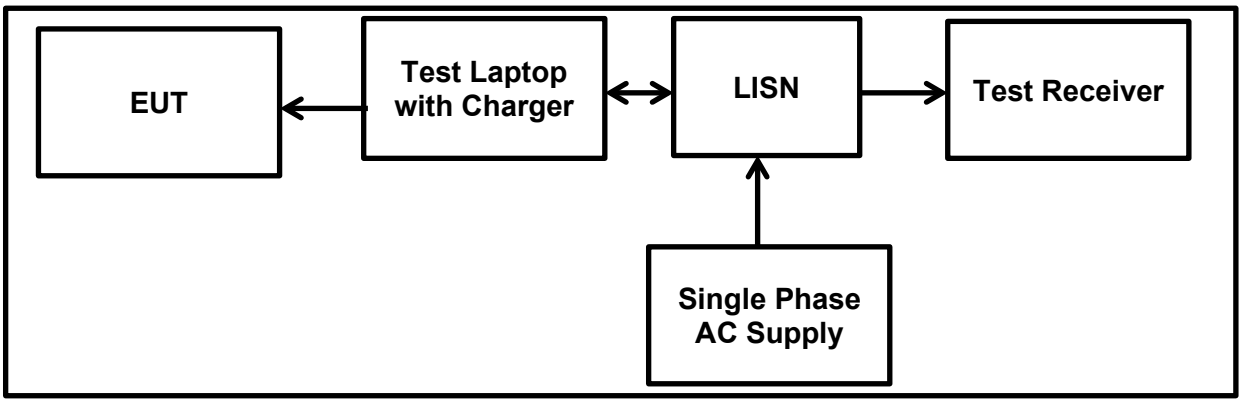
Detector	Quasi Peak/ Average

Note(s):

1. In accordance with FCC KDB 174176 Q4, tests were also performed with a 240 VAC 60 Hz single phase supply as this was within the voltage range marked on the 100-240 VAC~50/60 Hz power supply.
2. The EUT was powered via a USB-UART cable from the laptop. The laptop with its AC/DC power supply was connected with the LISN during the measurement.
3. The EUT was configured with the following worst-case mode w.r.t output power:
   - BT-LE | 1 Mbps | PRBS9 | PWR 5 | Bottom Channel
4. Pre-scans were performed, and markers placed on the highest live and neutral measured levels. Final measurements were performed on the marker frequencies and the results entered into the tables below.
5. The final measured value, for the given emission, in the table below incorporates the cable loss.
6. All other emissions shown on the pre-scan plot were investigated. Only the highest 6 emissions have been reported in the tables below in accordance with ANSI C63.10 section 6.2.5.
7. Measurements were performed in shielded room (SR7/ 8 Asset Number 1603671). The EUT was placed at a height of 80 cm above the reference ground plane and in a distance of 40 cm from the vertical ground plane at the edge of the table.
8. Measurement software used: Toyo EMI Software; CE measurement software EP5/CE Ver 4.0.1.

Transmitter AC Conducted Spurious Emissions (continued)

Test Setup:



Transmitter AC Conducted Spurious Emissions (continued)

Results: BT-LE / 1 Mbps / PRBS9 / Bottom Channel / PWR 5

Results: Live / Quasi Peak / 120 VAC 60 Hz

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.21756	Live	38.20	62.90	24.70	Complied
0.26486	Live	39.80	61.30	21.50	Complied
0.42994	Live	31.30	57.30	26.00	Complied
0.59992	Live	28.40	56.00	27.60	Complied
15.34704	Live	36.50	60.00	23.50	Complied
20.71777	Live	37.00	60.00	23.00	Complied

Results: Live / Average / 120 VAC 60 Hz

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.21756	Live	17.00	52.90	35.90	Complied
0.26486	Live	27.20	51.30	24.10	Complied
0.42994	Live	18.90	47.30	28.40	Complied
0.59992	Live	16.40	46.00	29.60	Complied
15.34704	Live	30.60	50.00	19.40	Complied
20.71777	Live	31.20	50.00	18.80	Complied

Results: Neutral / Quasi Peak / 120 VAC 60 Hz

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.20147	Neutral	42.90	63.50	20.60	Complied
0.24327	Neutral	40.30	62.00	21.70	Complied
0.73593	Neutral	24.50	56.00	31.50	Complied
3.10455	Neutral	21.60	56.00	34.40	Complied
15.54073	Neutral	36.20	60.00	23.80	Complied
20.53249	Neutral	36.10	60.00	23.90	Complied

Transmitter AC Conducted Spurious Emissions (continued)

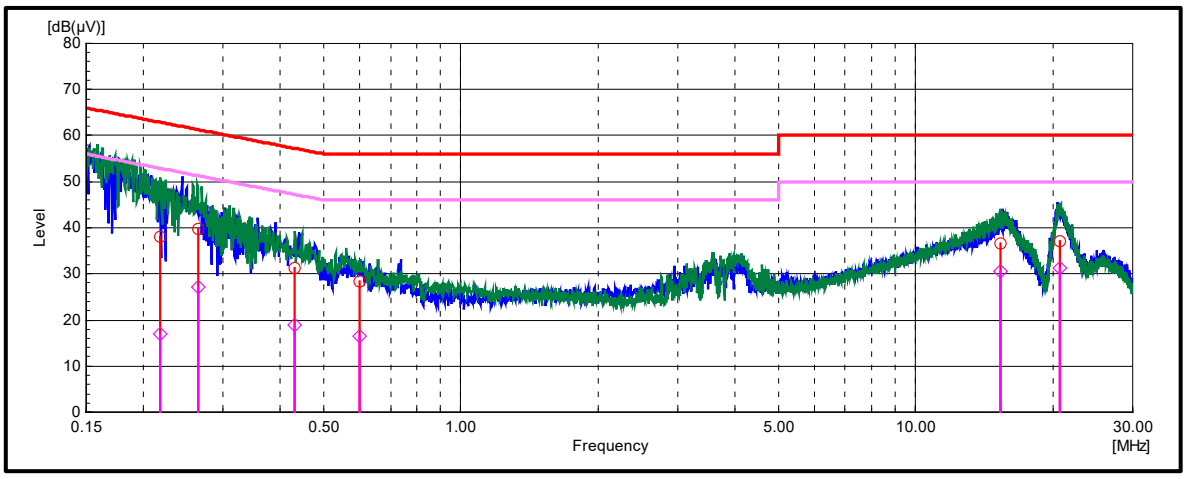
Results: BT-LE / 1 Mbps / PRBS9 / Bottom Channel / PWR 5

Results: Neutral / Average / 120 VAC 60 Hz

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.20147	Neutral	26.50	53.50	27.00	Complied
0.24327	Neutral	27.30	52.00	24.70	Complied
0.73593	Neutral	13.00	46.00	33.00	Complied
3.10455	Neutral	14.90	46.00	31.10	Complied
15.54073	Neutral	30.00	50.00	20.00	Complied
20.53249	Neutral	30.30	50.00	19.70	Complied

Result: Pass

Plot: Live and Neutral Line / 120 VAC 60 Hz



Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

Transmitter AC Conducted Spurious Emissions (continued)

Results: BT-LE / 1 Mbps / PRBS9 / Bottom Channel / PWR 5

Results: Live / Quasi Peak / 240 VAC 60 Hz

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.17848	Live	43.00	64.60	21.60	Complied
0.25282	Live	35.90	61.70	25.80	Complied
0.35353	Live	27.00	58.90	31.90	Complied
0.62978	Live	20.90	56.00	35.10	Complied
20.83634	Live	37.90	60.00	22.10	Complied

Results: Live / Average / 240 VAC 60 Hz

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.17848	Live	31.60	54.60	23.00	Complied
0.25282	Live	26.80	51.70	24.90	Complied
0.35353	Live	18.40	48.90	30.50	Complied
0.62978	Live	14.70	46.00	31.30	Complied
20.83634	Live	31.90	50.00	18.10	Complied

Results: Neutral / Quasi Peak / 240 VAC 60 Hz

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.16004	Neutral	46.30	65.50	19.20	Complied
0.17517	Neutral	43.90	64.70	20.80	Complied
0.51165	Neutral	33.90	56.00	22.10	Complied
0.70362	Neutral	11.90	56.00	44.10	Complied
2.75048	Neutral	18.70	56.00	37.30	Complied
17.10936	Neutral	26.00	60.00	34.00	Complied
20.49654	Neutral	41.60	60.00	18.40	Complied

Transmitter AC Conducted Spurious Emissions (continued)

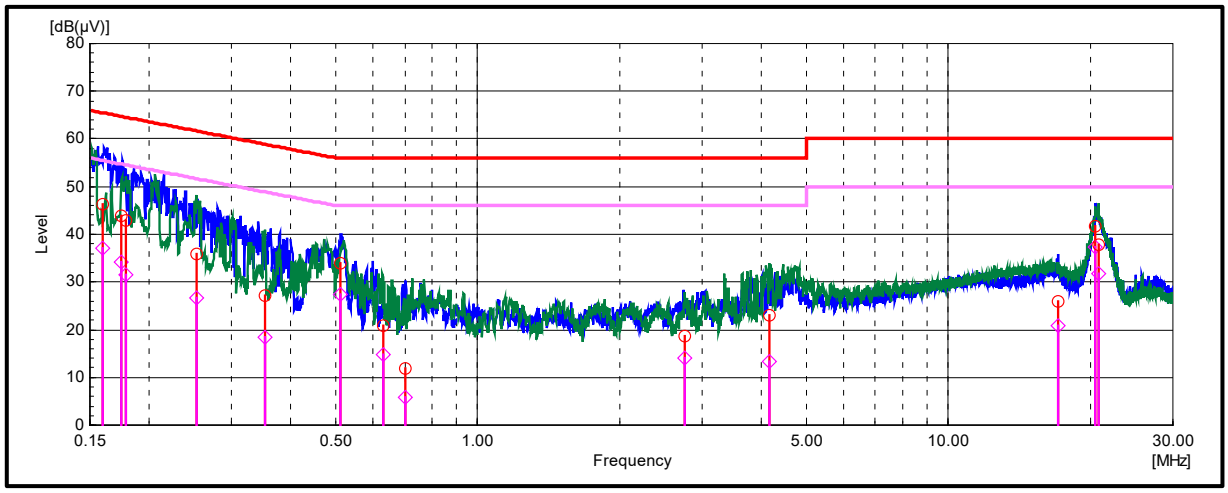
Results: BT-LE / 1 Mbps / PRBS9 / Bottom Channel / PWR 5

Results: Neutral / Average / 240 VAC 60 Hz

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.16004	Neutral	37.10	55.50	18.40	Complied
0.17517	Neutral	34.20	54.70	20.50	Complied
0.51165	Neutral	27.30	46.00	18.70	Complied
0.70362	Neutral	5.90	46.00	40.10	Complied
2.75048	Neutral	14.10	46.00	31.90	Complied
17.10936	Neutral	20.80	50.00	29.20	Complied
20.49654	Neutral	37.30	50.00	12.70	Complied

Result: Pass

Plot: Live and Neutral Line / 240 VAC 60 Hz



Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

5.2.2. Transmitter Duty Cycle

Test Summary:

Test Engineer:	Muhammad Faiq Khan	**Test Date:**	13 September 2023
Test Sample Serial Number:	Not Serialised (Conducted Test Sample with SMA connector)		
Test Site Identification	SR 9		

FCC Reference:	Part 15.35(c)
Test Method Used:	FCC KDB 558074 Section 6.0 referencing ANSI C63.10 Section 11.6

Environmental Conditions:

Temperature (°C):	23.6
Relative Humidity (%):	51.1

Note:

1. The transmitter duty cycle was measured using a spectrum analyser in the time domain and calculated by using the following calculation:

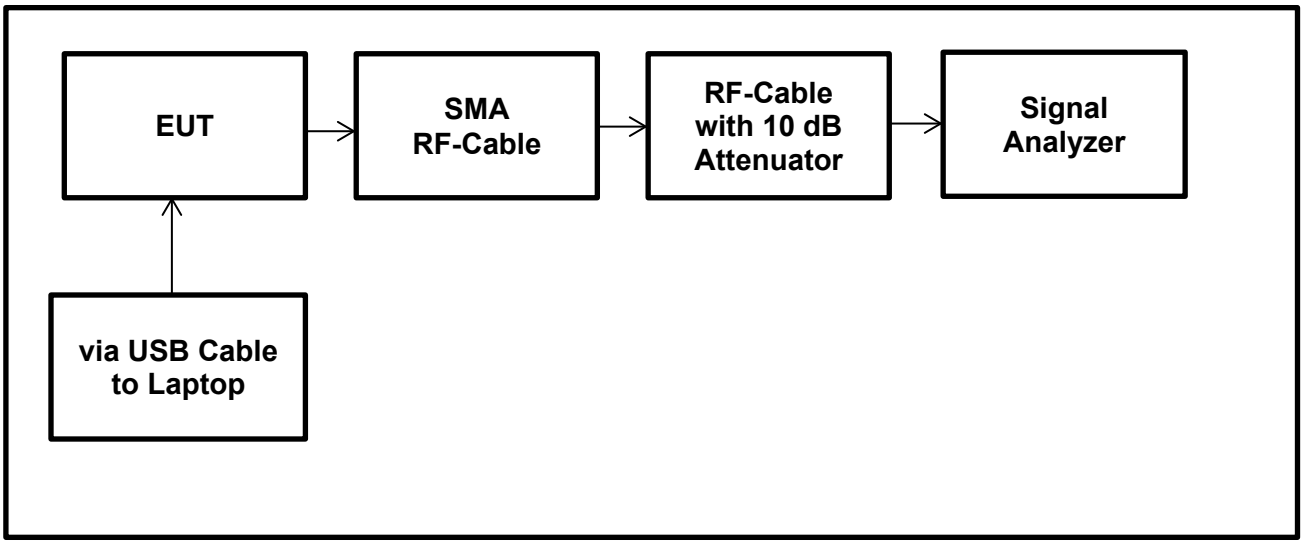
   Duty Cycle (%) = 100 X [On Time (T_{ON})] / [Period(T_{ON}+ T_{OFF}) or 100ms whichever is the lesser]

   Duty Cycle Correction Factor= 10 log 1 / [On Time (T_{ON})] / [Period(T_{ON}+ T_{OFF}) or 100ms whichever is the lesser]

2. The RF port on the EUT was connected to the spectrum analyser using suitable attenuation and RF cable. The measured values takes into consideration the external attenuation correction factors.
   - The SMA (Female) RF Cable soldered on PCB with maximum attenuation of 1 dB at the tested frequencies.
   - The RF cable attenuation maximum 0.5 dB@2.4GHz from the EUT to Analyzer including the 10 dB attenuation at the input of Spectrum Analyzer

Therefore, total a reference level offset 11.50 dB was added to each of the at the tested frequencies conducted plots

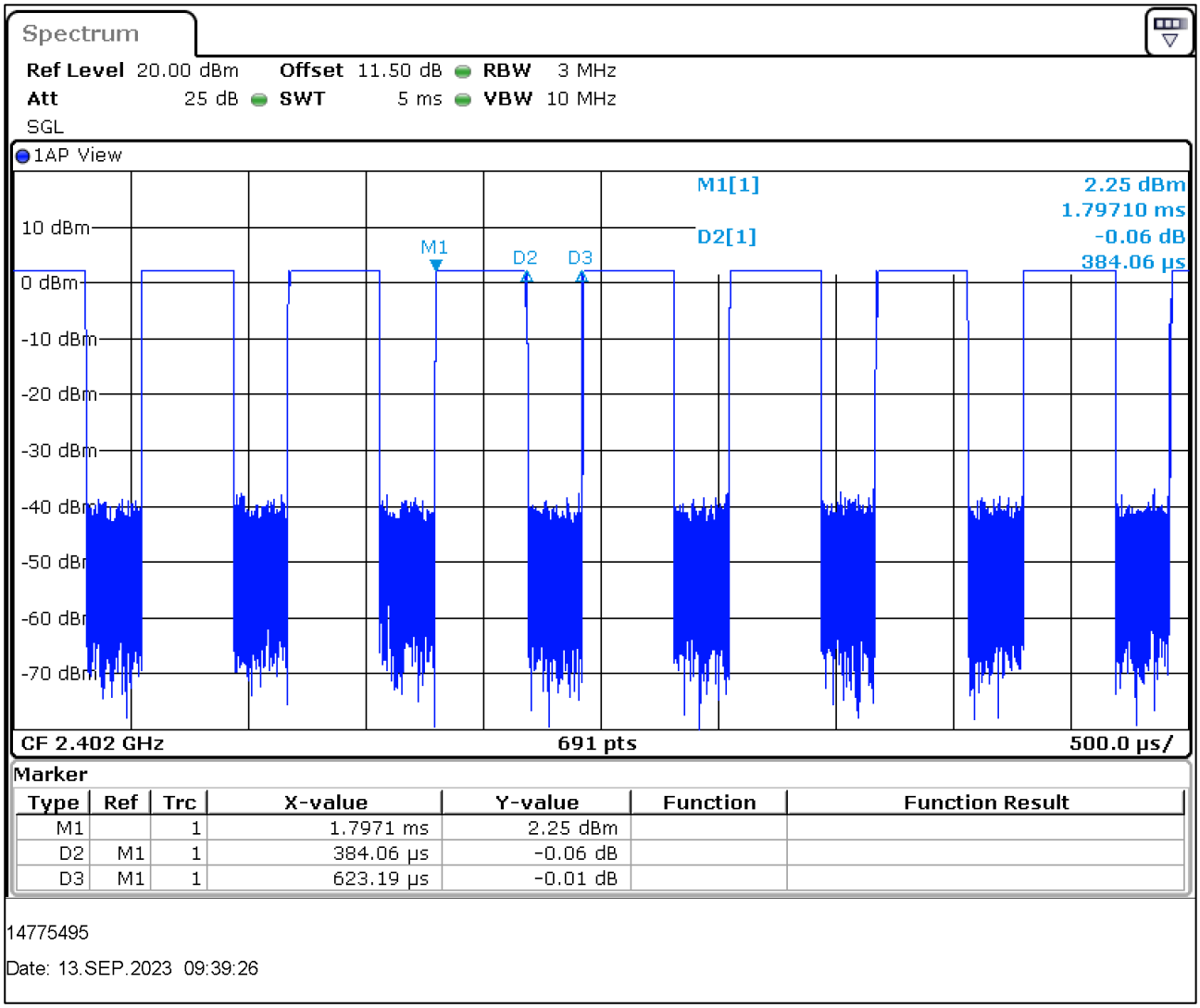
Test Setup:



Transmitter Duty Cycle (continued)

Results: BT-LE / 1 Mbps / PRBS9 / PWR 5 / Bottom Channel

Pulse On Time (T_{ON}) (µs)	Pulse Period (T_{ON} +T_{OFF}) (µs)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
384.06	623.19	61.62	2.1



Result: Pass

5.2.3. Transmitter Minimum 6 dB Bandwidth

Test Summary:

Test Engineer:	Muhammad Faiq Khan	**Test Date:**	13 September 2023
Test Sample Serial Number:	Not Serialised (Conducted Test Sample with SMA connector)		
Test Site Identification	SR 9		

FCC Reference:	Part 15.247(a)(2)
Test Method Used:	FCC KDB 558074 Section 8.2 referencing ANSI C63.10:2013 Section 11.8.1 Option 1

Environmental Conditions:

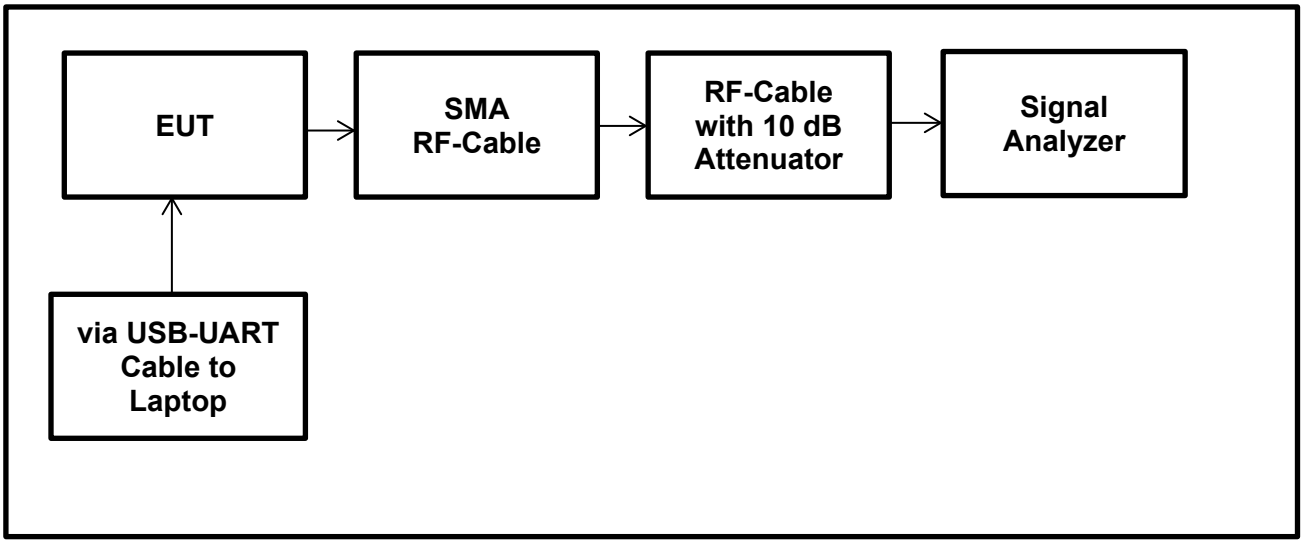
Temperature (°C):	23.6
Relative Humidity (%):	51.1

Notes:

1. The measurements were performed using the above configurations on the bottom, middle and top channels in accordance FCC KDB 558074 Section 8.2 referencing ANSI C63.10 Section 11.8 (11.8.1 Option 1 measurement procedure).
2. The spectrum analyser resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. A peak detector was used, sweep time was set to auto and the trace mode was Max Hold. The DTS bandwidth was measured at 6 dB down from the peak of the signal.
3. The RF port on the EUT was connected to the spectrum analyser using suitable attenuation and RF cable. The measured values takes into consideration the external attenuation correction factors.
    - The SMA (Female) RF Cable soldered on PCB with maximum attenuation of 1 dB at the tested frequencies.
    - The RF cable attenuation maximum 0.5 dB@2.4GHz from the EUT to Analyzer including the 10 dB attenuation at the input of Spectrum Analyzer

    Therefore, total a reference level offset 11.5 dB was added to each of the at the tested frequencies conducted plots.

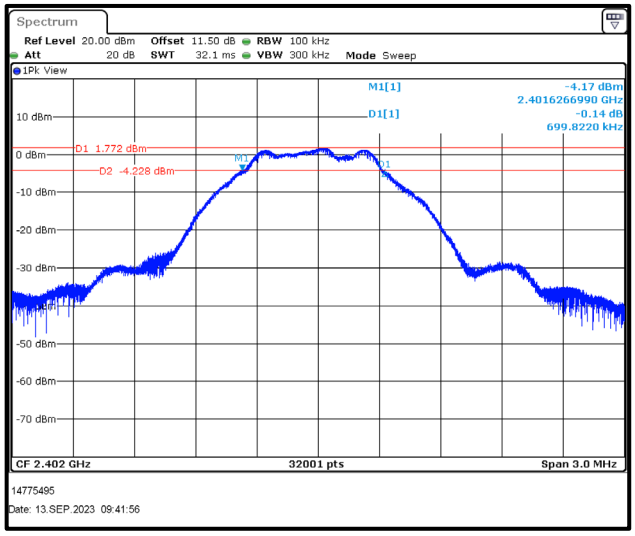
Test Setup:



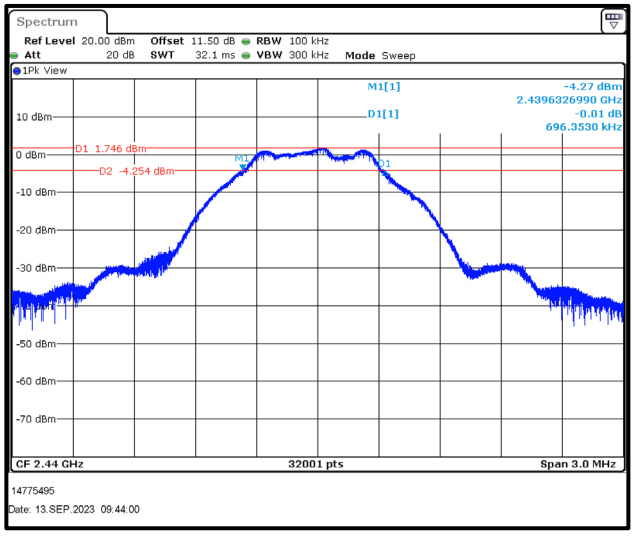
Transmitter Minimum 6 dB Bandwidth (continued)

Results: BT-LE / 1 Mbps / PRBS9 / PWR 5

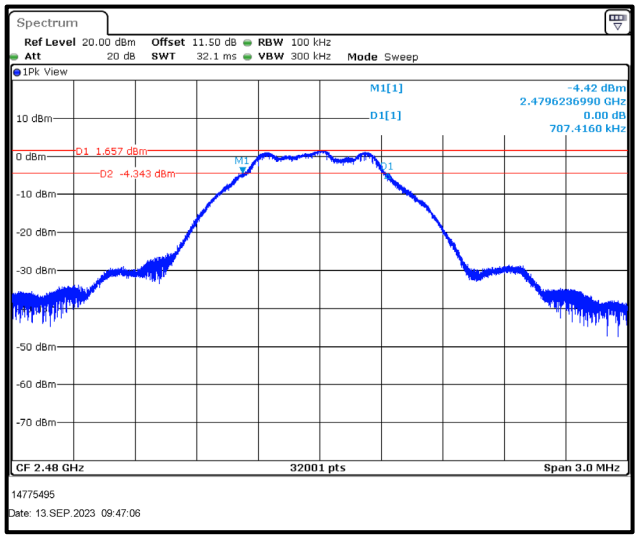
Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	699.822	≥ 500	199.822	Complied
Middle	696.353	≥ 500	196.353	Complied
Top	707.416	≥ 500	207.416	Complied



Bottom Channel



Middle Channel



Top Channel

Result: Pass

5.2.4. Transmitter Maximum (Peak) Output Power

Test Summary:

Test Engineer:	Muhammad Faiq Khan	**Test Date:**	13 September 2023
Test Sample Serial Number:	Not Serialised (Conducted Test Sample with SMA connector)		
Test Site Identification	SR 9		

FCC Reference:	Part 15.247(b)(3)
Test Method Used:	FCC KDB 558074 Section 8.3.1.1 referencing ANSI C63.10 Sections 11.9.1.1

Environmental Conditions:

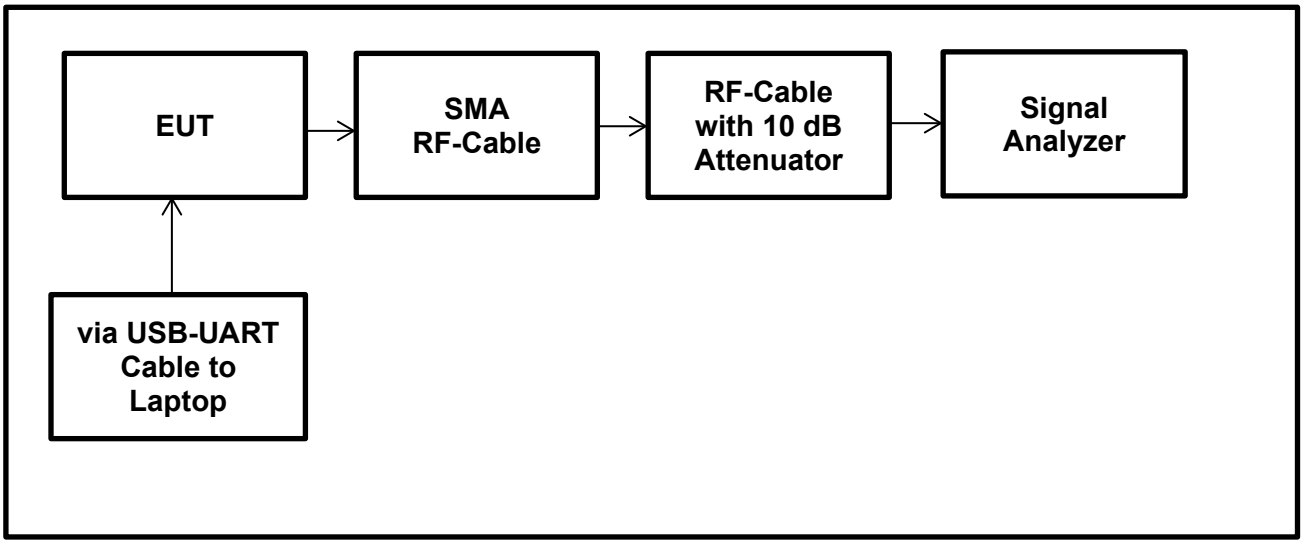
Temperature (°C):	23.6
Relative Humidity (%):	51.1

Notes:

1. Final measurements were performed using the below configurations on the bottom, middle and top channels.
2. The EUT was transmitting at <98% duty cycle and testing was performed in accordance with ANSI C63.10 Section 11.9.1.1 RBW ≥ DTS bandwidth Method.
3. The RF port on the EUT was connected to the spectrum analyser using suitable attenuation and RF cable. The measured values takes into consideration the external attenuation correction factors.
   - The SMA (Female) RF Cable soldered on PCB with maximum attenuation of 1 dB at the tested frequencies.
   - The RF cable attenuation maximum 0.5 dB@2.4GHz from the EUT to RF power meter including the 10 dB attenuation at the input of RF power meter.

   Therefore, total a reference level offset 11.5 dB was added to each of measured value at the tested frequencies.
4. The declared antenna gain was added to conducted power to obtain the relevant EIRP values.

Test Setup:



Transmitter Maximum Peak Output Power (continued)

Results: BT-LE / 1 Mbps / PRBS9 / PWR 5

Channel	Conducted Peak Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	1.96	30.00	28.04	Complied
Middle	1.91	30.00	28.09	Complied
Top	1.84	30.00	28.16	Complied

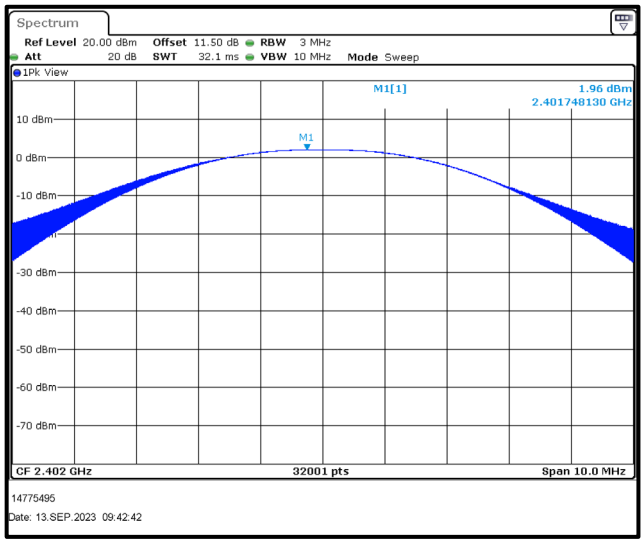
Results EIRP: BT-LE / 1 Mbps / PRBS9 / PWR 5

Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	1.96	2.4	4.36	36.00	31.64	Complied
Middle	1.91	2.4	4.31	36.00	31.69	Complied
Top	1.84	2.4	4.24	36.00	31.76	Complied

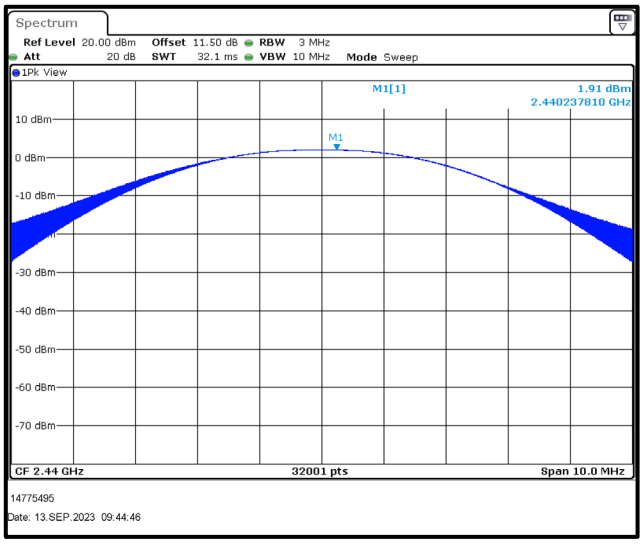
Result: Pass

Transmitter Maximum Peak Output Power (continued)

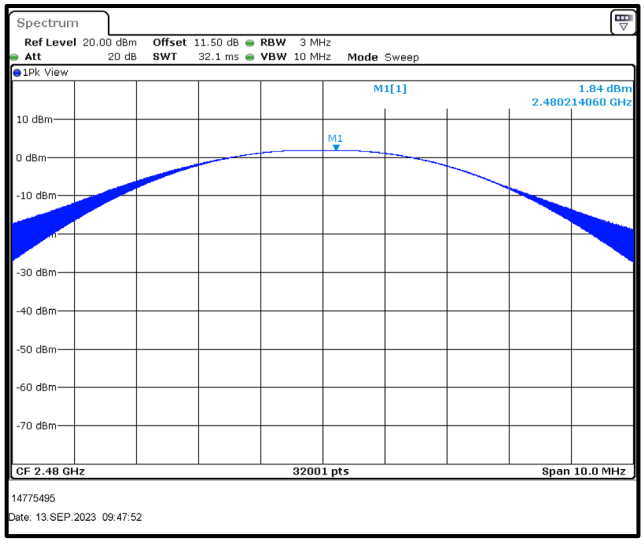
Plots: BT-LE / 1 Mbps / PRBS9 / PWR 5



Bottom Channel



Middle Channel



Top Channel

5.2.5. Transmitter Radiated Emissions

Test Summary:

Test Engineer:	Muhammad Faiq Khan	**Test Date:**	23 September 2023
Test Sample Serial Number:	Not Serialised (Radiated Test Sample)		
Test Site Identification	SR 1/2		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Test Method Used:	FCC KDB 558074 Sections 8.5 & 8.6 referencing ANSI C63.10 Sections 11.11 and 11.12 ANSI C63.10:2013 Sections 6.3 and 6.4
Frequency Range	9 kHz to 30 MHz

Environmental Conditions:

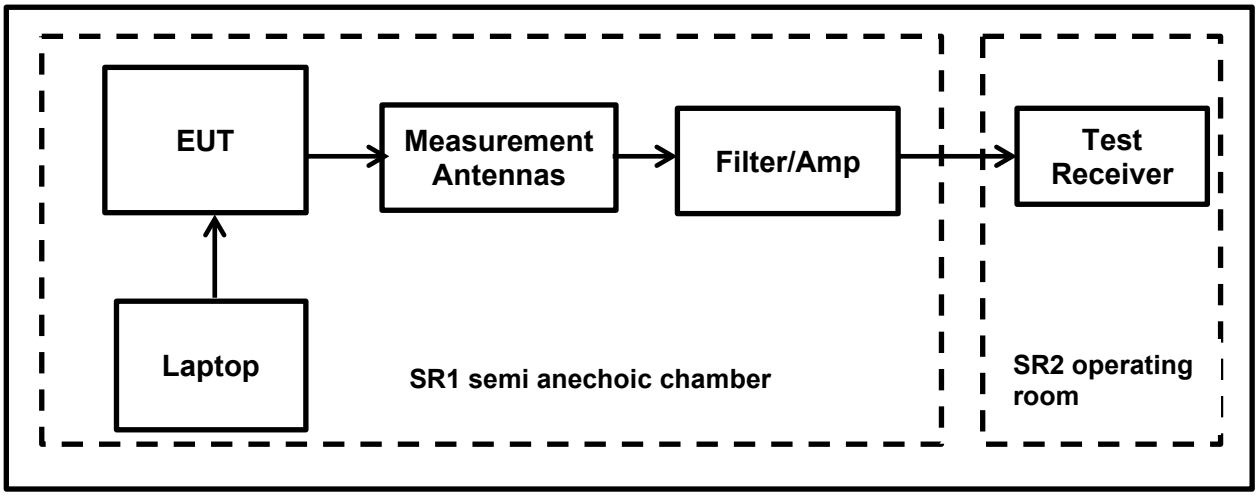
Temperature (°C):	24.1
Relative Humidity (%):	50.8

Notes:

1. In accordance with FCC KDB 414788 D01 Radiated Test Site & ANSI C63.10 clause 5.2 an alternative test site that can demonstrate equivalence to an open area test site may be used. Therefore, the measurement was performed in a Semi Anechoic Chamber. (The OATS / SAC comparison data is available upon request).
2. The limits are specified at a test distances of 30 and 300 metres. However, as specified in FCC Section 15.31 (f)(2) & ANSI C63.10 clause 6.4.3, measurements may be performed at a closer distance and the measured level extrapolated to the specified measurement distance using the method described in clauses 6.4.4, specifically sub-clause 6.4.4.1 which specifies that the measured level shall be extrapolated to the specified distance by conservatively presuming that the field strength decays at 40 dB/decade.
   Therefore, measurements were performed at a measurement distance of 3 m.
3. Therefore, the limit values are extrapolated to a measurement distance of 3 m.
   - 9 kHz- 490 kHz: limits extrapolated from 300 m to 3 m by adding 80 dB at 40 dB /decade.
   - 490 kHz-1705 kHz: limits extrapolated from 30 m to 3 m by adding 40 dB at 40 dB /decade.
4. Measurements below 30 MHz were performed in a semi-anechoic chamber SR1/ 2 (Asset Number 1603665) at a distance of 3 m. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. The measurement loop antenna height was 100 cm.
5. The EUT was configured with the following worst-case mode w.r.t output power:
   - BT-LE | 1 Mbps | PRBS9 | PWR 5 | Bottom Channel
6. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
7. Pre-scans were performed, and markers placed on the highest measured levels. The test receiver was set to:
   - Frequency range: 9 kHz-150 kHz: RBW: 300 Hz / VBW: 1 kHz
   - Frequency range: 150 kHz – 30 MHz: RBW: 10 kHz /VBW: 30 kHz
   - Detector: Max-Peak detector
   - Trace Mode: Max Hold

Transmitter Radiated Emissions (continued)

Test Setup:

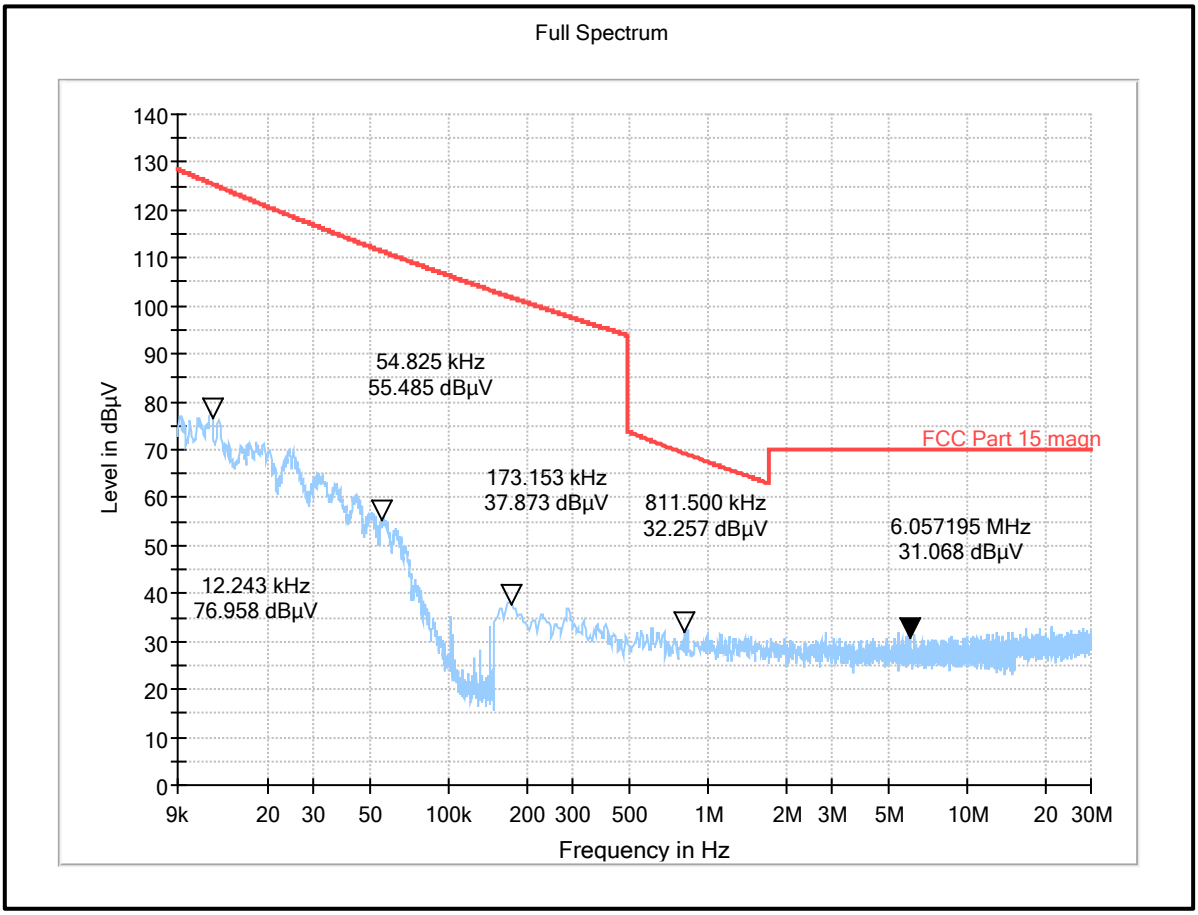


Transmitter Radiated Emissions (continued)

Results: BT-LE / 1 Mbps / PRBS9 / Bottom Channel / PWR 5

Frequency (MHz)	Loop Antenna Orientation	MaxPeak Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
No critical emissions were detected					

Plot: 9 kHz – 30 MHz: BT-LE / 1 Mbps / PRBS9 / PWR 5 / Bottom Channel



Result: Pass

Transmitter Radiated Emissions (continued)

Test Summary:

Test Engineer:	Muhammad Faiq Khan	**Test Date:**	23 September 2023
Test Sample Serial Number:	Not Serialised (Radiated Test Sample)		
Test Site Identification	SR 1/2		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Test Method Used:	FCC KDB 558074 Sections 8.5 & 8.6 referencing ANSI C63.10 Sections 11.11 and 11.12 ANSI C63.10:2013 Sections 6.3 and 6.5
Frequency Range:	30 MHz to 1000 MHz

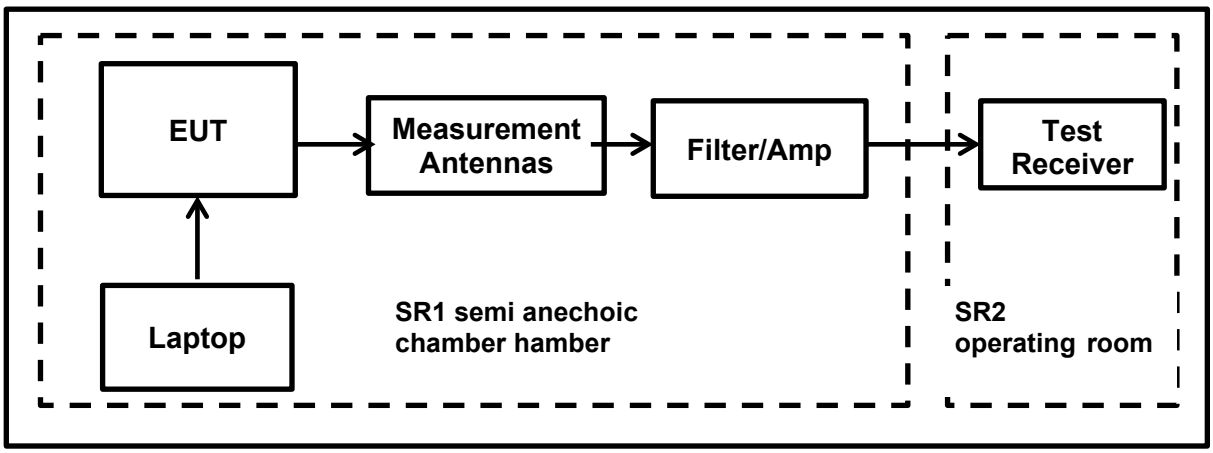
Environmental Conditions:

Temperature (°C):	23.5
Relative Humidity (%):	49.0

Note(s):

1. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0001) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
2. The EUT was configured with the following worst-case mode w.r.t output power:
    - BT-LE | 1 Mbps | PRBS9 | PWR 5 | Bottom Channel
3. Pre-scans were performed, and markers placed on the highest measured levels. The test receiver resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold.
4. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
5. All other emissions shown on the pre-scan plot were investigated and found to be below the measurement system noise floor.

Test Setup:

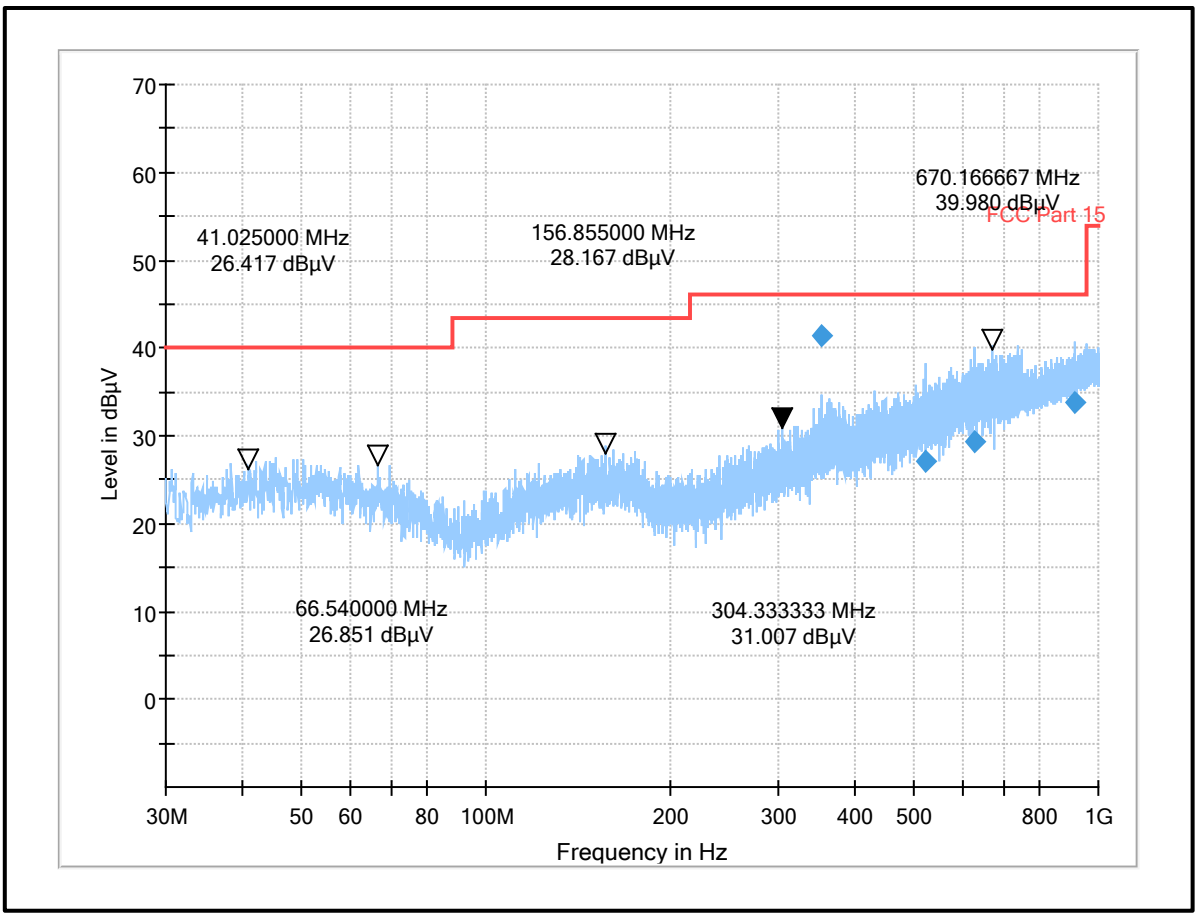


Transmitter Radiated Emissions (continued)

Results: BT-LE / 1 Mbps / PRBS9 / Bottom Channel / PWR 5

Frequency (MHz)	MaxPeak Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Antenna Polarization	Result
352.333333	41.50	46.00	4.50	Vertical	Complied
521.333333	27.18	46.00	18.82	Horizontal	Complied
629.666667	29.41	46.00	16.59	Vertical	Complied
916.125000	33.89	46.00	12.11	Horizontal	Complied

Plot: 30 MHz – 1GHz: BT-LE / 1 Mbps / PRBS9 / PWR 5 / Bottom Channel



Result: Pass

Transmitter Radiated Emissions (continued)

Test Summary:

Test Engineer:	Muhammad Faiq Khan	**Test Date:**	23 September 2023
Test Sample Serial Number:	Not Serialised (Radiated Test Sample)		
Test Site Identification	SR 1/2		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Test Method Used:	FCC KDB 558074 Sections 8.5 & 8.6 referencing ANSI C63.10 Sections 11.11 and 11.12 ANSI C63.10:2013 Sections 6.3 and 6.6
Frequency Range:	1 GHz to 26.5 GHz

Environmental Conditions:

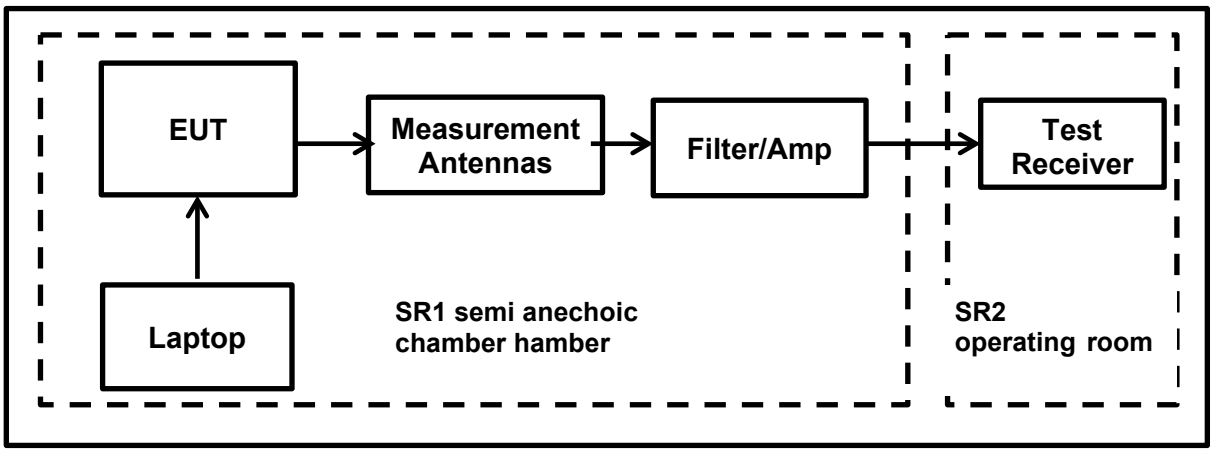
Temperature (°C):	23.5
Relative Humidity (%):	48.9

Notes:

1. Pre-scans above 1 GHz were performed in a semi-anechoic chamber SR1/ 2 (Asset Number 1603665) with RF absorbers on the floor at a distance of 3 m. The EUT was placed at a height of 1.5 m above the test chamber floor in the centre of the chamber turntable. All measurement antennas were placed at a fixed height of 1.5 m above the test chamber floor, in line with the EUT. Final measurements above 1 GHz were performed in a semi-anechoic chamber SR1/ 2 (Asset Number 1603665) with absorber on the floor at a distance of 3 m. The EUT was placed at a height of 1.5 m above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 m to 4 m.
2. The EUT was configured with the following worst-case mode w.r.t output power:
    - BT-LE | 1 Mbps | PRBS9 | PWR 5 | Bottom Channel
3. Pre-scans were performed, and a marker placed on the highest measured level of the appropriate plot. The test receiver resolution bandwidth was set to 1 MHz and video bandwidth 3 MHz the sweep time was set to auto.
4. In accordance with ANSI C63.10 Section 6.6.4.3 (Note 1), if the peak measured value complies with the average limit, it is unnecessary to perform an average measurement.
5. The emissions shown at frequencies approximately 2.4 GHz to 2.4835 GHz on the 1 GHz to 18 GHz plots are the EUT fundamental for the tested channel.
6. In accordance with ANSI C63.10-2013 Section 5.3.3 & 6.5.3 measurements above 18 GHz were performed at closer distance (1 m); because at specified measurement distance (3m) for compliance the instrumentation noise floor was typically close to the radiated emission limit.
7. For frequency range between 18 GHz and 26.5 GHz, no critical emissions were found. All emissions shown on the pre-scans were investigated and found to be below the noise floor of the measurement system
8. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.

Transmitter Radiated Emissions (continued)

Test Setup:

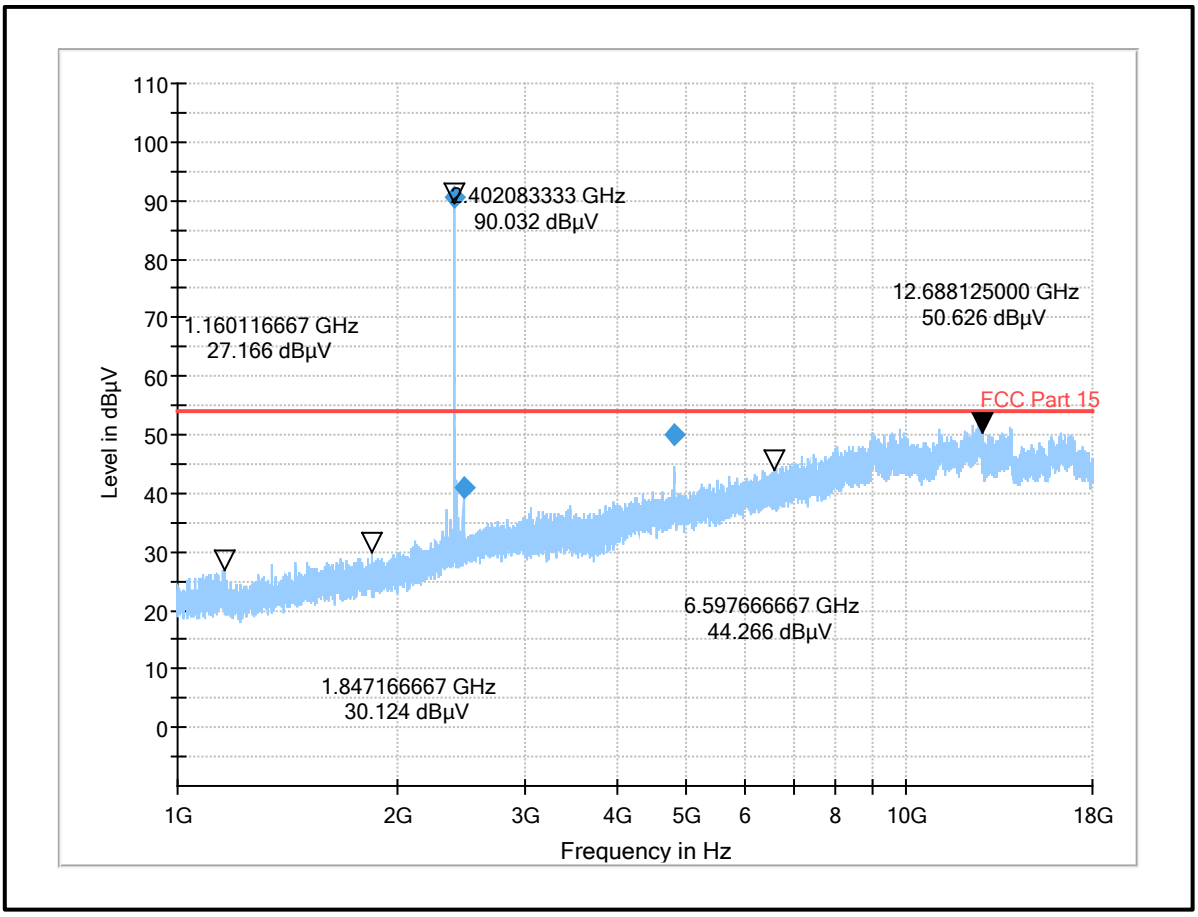


Transmitter Radiated Emissions (continued)

Results: BT-LE / 1 Mbps / PRBS9 / Bottom Channel / PWR 5

Frequency (MHz)	MaxPeak Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Antenna Polarization	Result
2465.900000	41.01	54.00	12.99	Horizontal	Complied
4804.333333	50.16	54.00	3.86	Horizontal	Complied

Plot: 1 GHz – 18 GHz: BT-LE / 1 Mbps / PRBS9 / PWR 5 / Bottom Channel

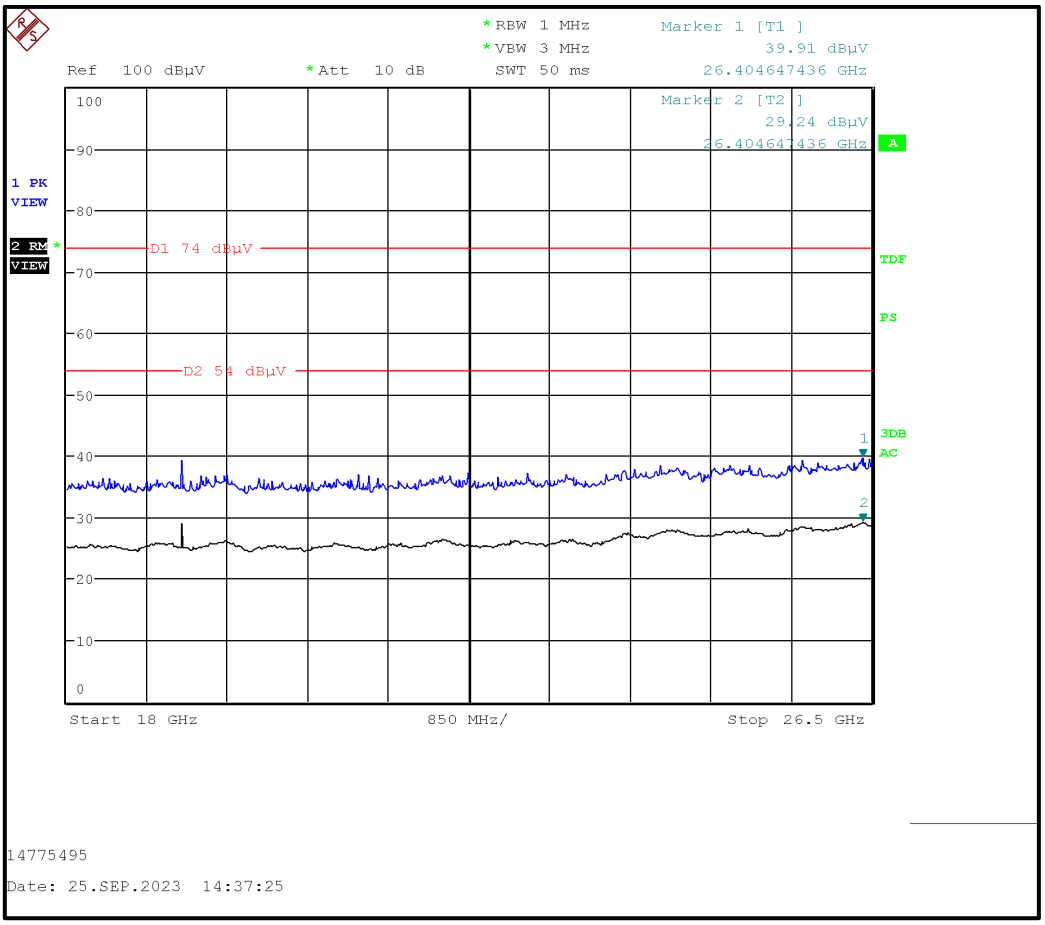


Result: Pass

Transmitter Radiated Emissions (continued)

Results: BT-LE / 1 Mbps / PRBS9 / Bottom Channel / PWR 5

Plot: 18 GHz – 26.5 GHz: BT-LE / 1 Mbps / PRBS9 / PWR 5 / Bottom Channel



5.2.6. Transmitter Band Edge Radiated Emissions

Test Summary:

Test Engineer:	Muhammad Faiq Khan	**Test Date:**	28. September 2023
Test Sample Serial Number:	Not Serialised (Radiated Test Sample)		
Test Site Identification	SR 1/2		

FCC Reference:	Parts 15.247(d), 15.209(a) & 15.205(a)
Test Method Used:	DTS emissions in non-restricted frequency bands: FCC KDB 558074 Section 8.5 referencing ANSI C63.10:2013 Sections 11.11
	DTS emissions in restricted frequency bands: FCC KDB 558074 Section 8.6 referencing ANSI C63.10:2013 Sections 11.12
	FCC KDB 558074 Section 8.7 referencing ANSI C63.10:2013 Sections 6.10.4, 6.10.5, 11.13

Environmental Conditions:

Temperature (°C):	25.6
Relative Humidity (%):	43.1

Note(s):

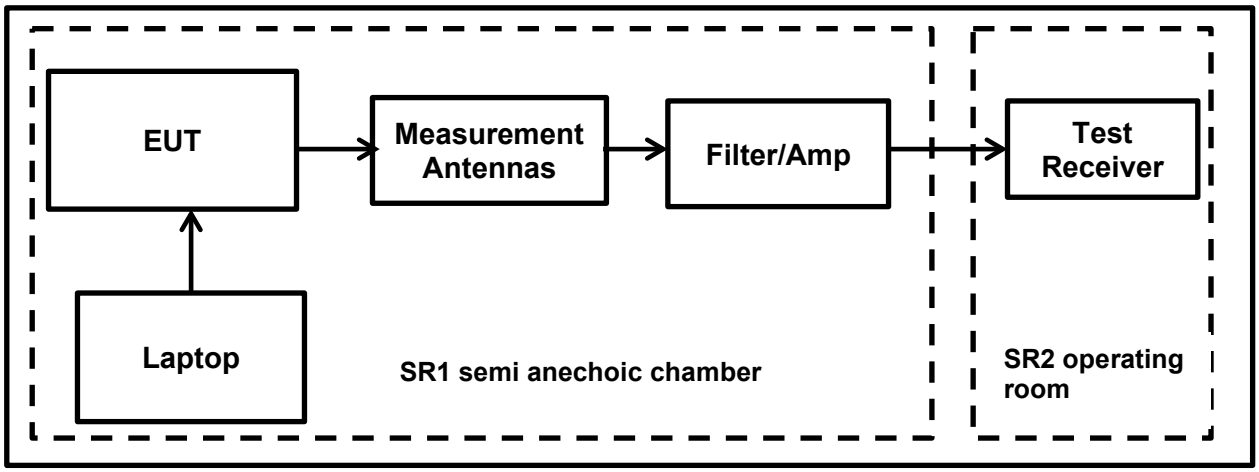
1. The measurements were in a semi-anechoic chamber SR1/ 2 (Asset Number 1603665) with RF absorbers on the floor at a distance of 3 m. The EUT was placed at a height of 1.5 m above the test chamber floor in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 m to 4 m
2. As the lower band edge falls within a non-restricted band, measurements were performed in accordance with FCC KDB 558074 Section 8.5 referencing ANSI C63.10 Section 11.11. Since maximum conducted (Peak) output power was previously measured in accordance with ANSI C63.10 Section 11.11.1(a) lower band edge measurement was performed with a peak detector and the -20 dBc limit applied.
3. As the lower band edge falls within a non-restricted band, only peak measurements are required. The test receiver resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold. The test receiver was left to sweep for 300 sweeps in order to maximise the carrier level and out-of-band emissions. A marker and corresponding reference level line were placed on the peak of the carrier. Marker frequencies and levels were recorded.
4. The restricted band peak measurements were performed in accordance with ANSI C63.10 Section 11.12.2.4.
5. As the upper band edge falls within a restricted band both peak and average measurements were recorded by placing a marker at the edge of the band. For peak measurements the test receiver resolution bandwidth was set to 1 MHz and the video bandwidth 3 MHz A peak detector was used, sweep time was set to auto and trace mode was Max Hold. For average measurements the test receiver resolution bandwidth was set to 1 MHz and the video bandwidth 3 MHz and RMS detector in linear power averaging mode was used. The test receiver was left to sweep for 300 sweeps in order to maximise the carrier level and out-of-band emissions. A marker was placed on the band edge spot frequencies and a second marker placed on the highest emission level in the adjacent restricted band of operation (where a higher-level emission was present). Marker frequencies and levels were recorded.
6. There is a restricted band 10 MHz below the lower band edge. The test receiver was set up as follows: the RBW set to 1 MHz, the VBW set to 3 MHz, with the sweep time set to auto couple. Peak and average measurements were performed with their respective detectors. Markers were placed on the highest point on each trace.

Transmitter Band Edge Radiated Emissions (continued)

Note(s): (continued)

7. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
8. As the continuous transmission of the EUT (D ≥ 98%) cannot be achieved and EUT was transmitting continuously with 61.62% duty cycle (+/- 2% tolerance). Duty Cycle Correction Factor of 2.1 dB was added to all average measurements.

Test Setup:



Transmitter Band Edge Radiated Emissions (continued)

Results: BT-LE / 1 Mbps / PRBS9 / PWR 5

Results: Lower Band Edge / Peak

Frequency (MHz)	Peak Level (dBµV/m)	-20 dBc Limit (dBµV/m)	Margin (dB)	Result
2399.90	55.99	76.36	20.37	Complied
2400.00	54.75	76.36	21.61	Complied

Results: 2310 to 2390 MHz Restricted Band / Peak

Frequency (MHz)	Peak Level (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)	Result
2389.72	54.09	74.00	19.91	Complied

Results: 2310 to 2390 MHz Restricted Band / Average

Frequency (MHz)	Average Level (dBµV/m)	Duty Cycle Correction Factor (dB)	Corrected Average Level (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)	Result
2338.01	35.13	2.1	37.23	54.00	16.77	Complied

Results: Upper Band Edge / Peak

Frequency (MHz)	Peak Level (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)	Result
2483.50	65.70	74.00	8.30	Complied
2483.58	65.66	74.00	8.34	Complied

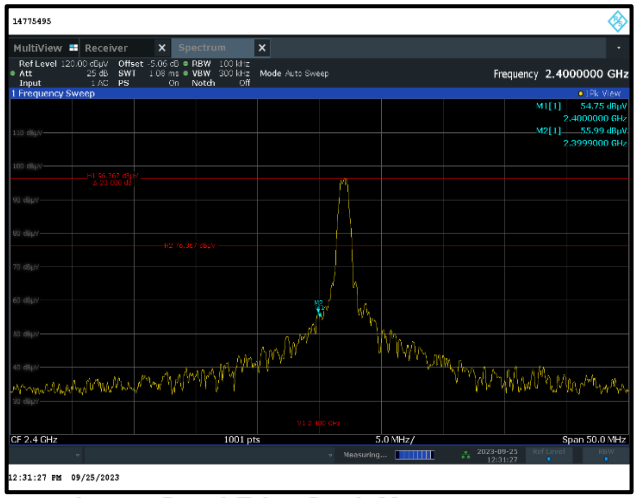
Results: Upper Band Edge / Average

Frequency (MHz)	Average Level (dBµV/m)	Duty Cycle Correction Factor (dB)	Corrected Average Level (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)	Result
2483.50	41.61	2.1	43.71	54.00	10.29	Complied
2483.58	41.07	2.1	43.17	54.00	10.83	Complied

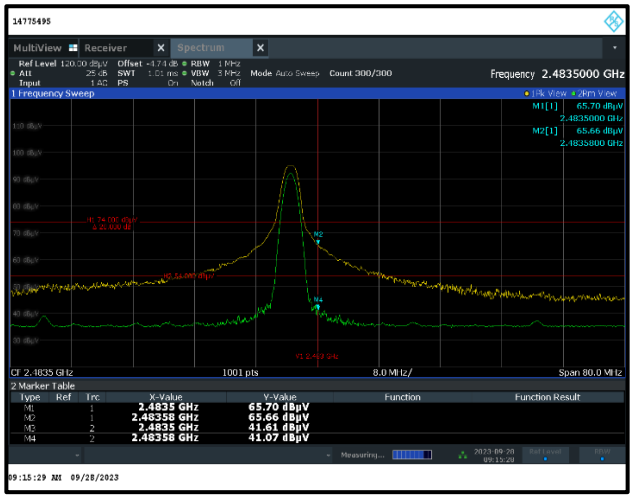
Result: Pass

Transmitter Band Edge Radiated Emissions (continued)

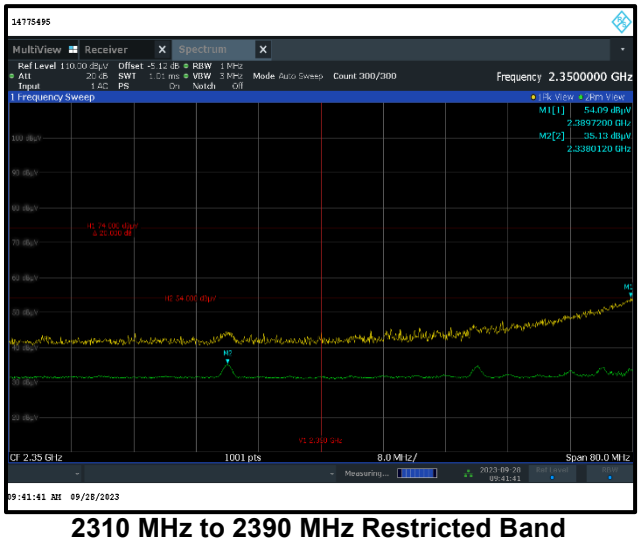
Results: BT-LE / 1 Mbps / PRBS9 / PWR 5



Lower Band Edge Peak Measurement



Upper Band Edge Peak & Average Measurement



2310 MHz to 2390 MHz Restricted Band

Result: Pass

6. Measurement Uncertainty

The expression of uncertainty of a measurement result allows realistic comparison of results with reference values and limits given in specifications and standards.

The uncertainty of the result may need to be taken into account when interpreting the measurement results.

The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor such that a confidence level of approximately 95% is maintained. For the purposes of this document “approximately” is interpreted as meaning “effectively” or “for most practical purposes”.

Measurement Type	Confidence Level (%)	Calculated Uncertainty
AC conducted emission	95%	±2.49 dB
Minimum 6 dB Bandwidth	95%	±0.87 %
Transmitter Duty Cycle	95%	±3.4%
Conducted Maximum Peak Output Power	95%	±0.59 dB
Radiated Spurious Emissions	95%	±3.10 dB
Band Edge Radiated Emissions	95%	±3.10 dB

The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty the published guidance of the appropriate accreditation body is followed.

7. Used equipment

Test site: SR 1/2

ID	Manufacturer	Type	Model	Serial	Calibration Date	Cal. Cycle (months)
1	Rohde & Schwarz	Antenna, Loop	HFH2-Z2	831247/012	18/07/2023	36
377	BONN Elektronik	Amplifier, Low Noise Pre	BLMA 0118-1A	025294B	18/07/2023	12
460	Deisel	Turntable	DT 4250 S	n/a	n/a	n/a
465	Schwarzbeck	Antenna, Trilog Broadband	VULB 9168	9168-240	02/09/2020	42
496	Rohde & Schwarz	Antenna, log. - periodical	HL050	100297	22/08/2022	24
588	Maturo	Controller	NCD	029/7180311	n/a	n/a
591	Rohde & Schwarz	Receiver	ESU 40	100244/040	13/07/2023	12
669	Rohde & Schwarz	EMI Test Receiver	ESW 44	103087	13/07/2023	18
607	Schwarzbeck	Antenna broadband horn antenna	BBHA 9170	9170-561	15/10/2019	48
608	Rohde & Schwarz	Switch Matrix	OSP 120	101227	lab verification	n/a
628	Maturo	Antenna mast	CAM 4.0-P	224/19590716	n/a	n/a
629	Maturo	Kippeinrichtung	KE 2.5-R-M	MAT002	n/a	n/a
-/-	Testo	Thermo-Hygrometer	608-H1	01	lab verification	n/a
328	SPS	AC/DC power distribution system	PAS 5000	A2464 00/2 0200	lab verification	n/a
1603665	Siemens Matsushita Components	semi-anechoic chamber SR1/ 2	-/-	B83117-A1421-T161	n/a	n/a
681	Maturo	Antenna mast, tilting	BAM4.5-P	402/0718.1	n/a	n/a

Test site: SR 9

ID	Manufacturer	Type	Model	Serial	Calibration Date	Cal. Cycle (months)
625	Schwarzbeck	Antenna, H-field	HFSL 7101	109	lab verification only relative measurements	n/a
637	Rohde & Schwarz	Spectrum Analyser	FSV40	101587	12/07/2023	12
327	SPS	AC/DC power distribution system	PAS 5000	A2464 00/1 0200	lab verification	n/a
-/-	Testo	Thermo-Hygrometer	608-H1	07	lab verification	n/a
645	Weiss Umwelttechnik	Climatic Chamber	LabEvent T/110/70/3	5822619794 0010	lab verification	n/a

Test site: SR 7/8

ID	Manufacturer	Type	Model	Serial No.	Calibration Date	Cal. Cycle
22	Rohde & Schwarz	Artificial Mains	ESH3-Z5	831767/014	18.07.2023	12
23	Rohde & Schwarz	Artificial Mains	ESH3-Z5	831767/013	18.07.2023	12
28	Rohde & Schwarz	Passive Probe	ESH2-Z3	none	13.07.2022	36
215	Rohde & Schwarz	Artificial Mains Network	ESH2-Z5	879675/002	18.07.2023	24
349	Rohde & Schwarz	Receiver, EMI Test	ESIB7	836697/009	18.07.2023	12
351	Rohde & Schwarz	network, Artificial Mains	ESH3-Z5	862770/018	18.07.2023	12
505	Rohde & Schwarz	Absorbing Clamp	MDS21	100005	21.07.2023	48

8. Report Revision History

Version Number	Revision Details		
	Page No(s)	**Clause**	**Details**
1.0	39	-	Initial Version
1.1	8	3.5	Antenna gain info updated
	20	5.2.3	Transmitter 6dB results updated
	22	5.2.4	Antenna gain info and result tables updated
Test Report Version 1.2 supersede Version 1.1 with immediate effect Test Report No. UL-RPT-RP-14775495-616-FCC Version 1.2, Issue Date 14 MAY 2024 replaces Test Report No. UL-RPT-RP-14775495-616-FCC Version 1.1, Issue Date 07 MAY 2024, which is no longer valid.			
1.2	**as below**	**as below**	**Current Version**
	1	front	Test report number updated on front page and on header

--- END OF REPORT ---